The Use of Native Warm Season Grasses for Critical Area Stabilization

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Native warm season grasses are indigenous to the Northeastern United States but now are found growing naturally only in isolated pockets throughout the region. When Europeans arrived on the continent, there were some impressive grasslands contained within the eastern forest, primarily in burned areas and in "barrens" or rocky outcrops. Now, the most extensive remnants are found along the coastal strip/barrier islands, railroad/utility rights-of-way and in natural areas along major river systems. The most common warm season grasses found include: switchgrass [*Panicum virgatum* L.], coastal panicgrass [*Panicum amarum* Elliott], big bluestem [*Andropogon gerardii* Vitman], little bluestem [*Schizachyrium scoparium* (Michx.) Nash], Indiangrass [*Sorghastrum nutans* (L.) Nash], deertongue [*Dichanthelium clandestinum* (L.) Gould], purpletop [*Tridens flavus* (L.) Hitchc.], eastern gamagrass [*Tripsacum dactyloides* (L.) L.] and the cordgrasses [*Spartina spp*.

These native warm season grasses provide extremely valuable habitat for ground-nesting birds and many mammals. They are very deep rooted, making for long lasting, stress tolerant, low maintenance plants. The root biomass of native warm season grasses far exceeds that of the introduced cool season grasses. This characteristic provides increased organic matter in soils and more rapid infiltration rates. The bunch-type habit of these grasses provides space for the inclusion of native forbs and legumes to further improve habitat quality. Although these attributes of the native grasses are well documented, there has been a reluctance to utilize them in the Northeast, particularly for the purpose of erosion control.

The Northeast has a long history of utilizing introduced cool season turf and forage grasses for erosion control. Introduced cool season grasses such as perennial ryegrass *[Lolium perenne* L.], Kentucky bluegrass [*Poa pratensis* L.], tall fescue [*Festuca arundinacea* Schreb.], and orchardgrass [*Dactylis glomerata* L.], are readily available, relatively inexpensive and have good seedling vigor which is useful for quick stabilization. In addition, the cool season grasses may be seeded almost year-round, except during the typical midsummer dry period. Conversely, the native warm season grasses are not as readily available, are

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more expensive, and have relatively low seedling vigor compared to cool-season grasses, which results in a longer establishment period.

There are other reasons for reluctance to using warm season grasses. A warm season grass seedling partitions initial energy into root development so seedlings are vulnerable to competition and frost heave until the end of the second growing season. The primary seeding window is limited to the early spring, but late fall/early winter seedings are a possible option on droughty soils with little weed competition. There is no late summer/early fall seeding window as with cool season grasses. Many of the warm season grasses produce chaffy seeds with long awns, which do not efficiently flow through a conventional grass seeder. As a result, specialized seed drills, which handle this type of seed, are needed, but have not been commonly available in the Northeast. However, recent purchases of native grass seed drills by Soil Conservation Districts, grass-roots environmental and wildlife organizations, and the U.S. Fish and Wildlife Service have greatly improved the availability of native grass drills in the Northeast region.

In general, warm season grasses have more exacting requirements for establishment than do cool season grasses. However, the benefits of utilizing the native grasses far outweigh the potential difficulties encountered. This article intends to minimize the concerns with establishing native warm season grasses for erosion control by presenting recommendations which have proven to be successful in the Northeast for the last eighteen years.

Site Selection

Suitable planting sites for warm season grasses have the following attributes:

1. Soil drainage class of moderately well drained or better, with no history of frost heave. Frost heave is less of a threat in states with longer and/or warmer summers than we have in New York, Vermont, New Hampshire, Maine, Massachusetts, and southeastern Canada. Even within the frost heave area, sandy or gravely soils rarely have this problem.

2. Good control of perennial cool season grasses and forbs. Weed competition is typically much lower on critical area stabilization sites such as mined areas, sanitary landfill caps, and other disturbed areas due to poor soil conditions.

3. At least a 100-day frost-free season, and 1600 growing degree days (corn formula).

4. Full sun with south, west and east exposures at elevations below 2000 feet in plant hardiness zone 3 or warmer. A northern exposure limits elevations to below 1500 ft. and to slopes of less than 20 degrees in plant hardiness zone 4 or warmer. Add 500 feet to elevation limits for each warmer hardiness zone.

5. Soil pH of 5.5 or higher with moderate or low N, P, K.

Site Preparation

The area to be planted should be firm and free of weeds, large rocks, stumps and other debris over 2" in diameter.

Weed competition is typically not a problem on critical area planting sites due to the sterile, droughty soil conditions which often exist in disturbed areas. However, perennial cool season grasses pose the biggest threat to warm season grass establishment and must be addressed the year prior to planting if they are present. Contact herbicides such as Roundup, Poast, Fusilade, Gramoxone, 2,4-D, and Banvel combined with tillage, are effective ways to eliminate perennial weeds. All herbicides must be used according to the label requirements.

Planting Procedure

Switchgrass, coastal panicgrass, deertongue, purpletop, and eastern gamagrass can be planted with conventional grass or grain seeding equipment because the seed will meter through the feed mechanisms. The bluestems, Indiangrass, and cordgrass have chaffy seed which requires either broadcasting or a native grass drill with "picker wheel" feed mechanisms and hopper agitation. Eastern gamagrass can be planted with a corn planter if a forage stand is desired.

Drills should be set to plant 0.25 to 0.5 inch deep. Depth bands help with this, otherwise careful adjustment of the drill pressure is required. Eastern gamagrass does best at depths of 1 to 1.5 inches.

In the Northeast, availability of native grass drills has been minimal. In addition, some sites do not lend themselves to drilling because of slope steepness or coarse soil texture. So where the chaffy grasses are part of the seed mix, broadcasting onto a prepared seedbed is sometimes a necessity. Under these conditions, a second pass over the site with a cultipacker (with tines raised) or a bulldozer (tracking) must be used to incorporate the seed into the soil. Hydroseeding without tracking or cultipacking is unacceptable. Mixing chaffy seed with dry vermiculite or oat seed will sometimes allow for flow through fertilizer spreaders, but this takes some experience with particular machines to make it work.

Apply mulch if needed. Acceptable amounts of mulch (0.5-1.0 ton ac^{-1}) can vary based upon the planting method to be used, but heavy mulching (2 ton ac^{-1}.) rates are unacceptable because this will hinder soil warming and light penetration to the developing seedlings.

Planting Dates

The ideal planting dates for seeding warm season grasses range from April 15 in the Mid-Atlantic States to May 15 in northern New England. This roughly approximates corn planting season. Late plantings increase the risk of frost heave on moderately well drained soils, because the seedlings will not be as large as they would have been with a longer growing season. Late plantings also increase the risk of hitting a dry period, and further delaying germination. However, delaying planting to the end of corn planting season is justified if final weed control is required. Where weed control has been very effective the year prior to planting, and/or droughty soils are present, an early planting (one to three weeks prior to corn planting) is possible.

If a cover crop is needed over the winter, plant oats in late August or early September. The oats will winterkill, thus not requiring herbicide kill in the spring, unless there are other grasses or weeds germinating at that time.

Seeding Rates

Warm season grass seed is sold, and planted, based upon pure live seed pounds (PLS lb.). This means that the gross weight of seed is increased to compensate for the inert material and dead seed in the given seed lot. Buying mixtures of seed is not recommended, rather buy the seed needed and make the mix just prior to planting. This allows for better quality control, and for greater flexibility in using planting equipment. For instance, a seed like switchgrass which "flow" can be planted out of a small seed box on a conventional drill. Smooth, flowable seeds tend to settle out of a mix with the chaffy seeds as the drill bounces across the field.

Typical Grass Seeding Rates

Core Mix:

(Use high range if broadcast or hydroseeding)

Switchgrass or Coastal panicgrass; 2-5 PLS lbs ac^{-1}
Big bluestem; 3-7 PLS lbs ac^{-1}
Little bluestem; 4-6 PLS lbs ac^{-1}
Indiangrass; 3-7 PLS lbs ac^{-1}
Deertongue; 5-8 PLS lbs ac^{-1}

Optional additions to core seed mix if quick cover is needed for erosion control

Nurse grasses for quick cover:

Oats [*Avena sativa* L.] – 30 lbs ac^{-1} **or**
Annual ryegrass [*Lolium multiflorum* Lam.] -10 lbs ac^{-1}

Plus: companion grasses for initial and short-term cover

Redtop [*Agrostis gigantea* Roth.] -1 lbs ac^{-1} **or**
Canada wildrye [*Elymus canadensis* L.] – 5 lbs ac^{-1} **or**
Fine fescue [*Festuca spp*.] - 15 lbs ac^{-1}

Fine fescues include: red fescue [*Festuca rubra* L.], hard fescue [*Festuca brevipila* R. Tracy], Chewing's fescue [*Festuca rubra var. commutata* Gaudin], and sheep fescue [*Festuca ovina* L.]

Choose these companion (cool season) grasses based on availability, price and seeding objectives. Redtop is acid tolerant and will withstand short periods of drought. Persistence is much longer on wetter, poorly drained sites, however these sites are poor candidates for warm season grasses. Canada wildrye has fair drought tolerance, but good salt tolerance. The fine fescues will persist for many years under droughty, acid, and sterile soil conditions.

Adding the following legumes improves soil conditioning and habitat quality: select one or two)

Partridge pea [Chamaecrista fasciculata (Michx.) Greene]	4	
Round-headed bush clover [*Lespedeza capitata* Michx.]	2	
Wild indigo [*Baptisia tinctoria* (L.) R.Br.]		2
Birdsfoot trefoil [*Lotus corniculatus L.*]	3	
Clover [Trifolium spp.]	2	

RECOMMENDED WARM SEASON GRASS CULTIVARS FOR THE NORTHEAST

GRASS SPECIES	CULTIVAR(S)
Big bluestem *[Andropogon gerardii Vitman]*	Niagara, Kaw
Coastal panicgrass *[Panicum amarum var. amarulum (Hitchc. & Chase) P.G. Palmer]*	Atlantic
Deertongue *[Dichanthelium clandestinum* (L.) Gould*]*	Tioga
Eastern gamagrass [*Tripsacum dactyloides* (L.) L.]	Pete

Indiangrass *[Sorghastrum nutans* (L.) Nash*]*	Rumsey, Osage, NE-54
Little bluestem *[Schizachyrium scoparium* (Michx.) Nash]	Aldous, Camper**,** Blaze
Sand bluestem [*Andropogon hallii* Hack.]	Goldstrike
Sand lovegrass *[Eragrostis trichodes (Nutt.)* A.W. Wood]	Bend**,** Nebraska 27
Saltmeadow cordgrass *[Spartina patens* (Aiton) H.L. Muhl.]	Avalon
Smooth cordgrass *[Spartina alterniflora* Loisel.]	Bayshore
Switchgrass *[Panicum virgatum* L.**]**	Blackwell (critical sites) Cave-in-Rock (forage-north) Carthage (forage-south) Shelter (wildlife)

Managing the Establishing Stand

Warm season grasses are slower to germinate than cool season grasses, often taking 14-21 days before the seedlings can be seen. To determine what is coming up gently pass your hand just over the soil surface and “feel” the emerging leaves, then dig up some seedlings to find and identify the seed coats.

Unfortunately, weeds do not have low seedling vigor. The best treatment, when weeds begin to shade the grass seedlings, is to clip the weeds just above the grass leaves with a sickle-bar mower. Cut off as little grass leaf surface as possible although a leaf tip here and there is no problem. Two to three clippings are almost always needed during the first growing season, sometimes more. A rotary mower can be used as long as it can be elevated high enough, but it tends to leave clippings in wads and windrows rather than thinly and evenly deposited over the field.

Dry weather after the seedlings are 3-4 inches tall is not a problem and, in fact, will help the warm season grass by putting the brakes on the cool season grass seedlings that are sure to be growing along with the plants desired. Therefore, irrigation is not warranted.

Fertilizer applications are recommended only if the area is essentially weed free in mid-July to early August. Apply 30-40 pounds per acre of nitrogen to give the warm season grasses a boost, but do not apply any after August 1 in the northern states or August 20 in the southern part of the region.

When broad-leaved weeds are a problem, Banvel and 2,4-D are the herbicides of choice. These can be used once the planted grasses are six inches tall with at least four leaves. All herbicides must be used following label requirements.

Second Year Management

There may be an opportunity to control cool season grasses by spot treatment during the spring. If sufficient growth occurs on the cool season grasses before any green growth appears on the warm season grasses, judicious use of Roundup is possible.

Annual weeds will be crowded by the developing stand of warm season grasses and are rarely a factor in stands with good density after year one.

For forage plantings, apply 60 lb. ac^{-1} of nitrogen after the grass has about six inches of growth. Forage harvests, as hay or pasture, should begin as the stems begin to elongate (early boot stage), and end six weeks before expected frost. Grazing should follow an intensive rotational system. Harvest should allow at least six inches height to remain. Consult other references for detailed harvest strategies.

Case Studies

<u>New York/Northern New England</u>

1. Franklin Co, NY (extreme northern NY), Plant Hardiness Zone 4. Gravel pit planting in 1975 comparing cool season and warm season grass varieties for long term droughty site persistence. Cool season grasses were ineffective for erosion control and wildlife habitat. Warm season grasses provided good cover and microsites for native woody vegetation establishment. Plantings were part of a 10-site 6-state test which was reported in the Journal of Soil and Water Conservation, Sept-Oct, 1987. These plots served as the basis for matching plant species selection to soils based on percent fines passing #200 mesh sieve.

2. Gravel pit near Montpelier, VT, Plant Hardiness Zone 4. Planted in 1985 using warm-season grass mix including ‘Niagara’ big bluestem, ‘Blackwell’ switchgrass, ‘Osage’ Indiangrass, and ‘Aldous’ little bluestem. This site was used as a demonstration of tracking in the seed with a bulldozer. This planting method has been found repeatedly to be superior on steep slopes where the use of a seed drill is impossible. The tracking technique following broadcasting (by hand, mechanically, or hydroseeder) results in excellent germination in the cleat tracks. The difference is typically dozens of seedlings per square foot vs. 0-2 seedlings per square foot where only surface application is done.

3. Soil bioengineering planting in November, 1988, near Gaysville, VT on a steep, dry slope. ‘Cape’ American beachgrass [*Ammophila breviligulata* Fernald] planted between contour lines of ‘Streamco’ purpleosier willow [*Salix purpurea* L.]

wattles. Cape performed well for a few years until the willows eventually dominated. This combination stabilized the slope by creating a favorable microclimate for seed recruitment from the adjacent native trees and.

4. Soil bioengineering, tidal stream, Wells, ME, Plant Hardiness Zone 5. Emergency Watershed Protection planting in June 1993 following severe spring flooding. Bank erosion within 8 ft from house foundations. Combination planting of 'Streamco' purpleosier willow, 'Bankers' dwarf willow [*Salix cottetii* Jos. Kern], and 'Cape' American beachgrass were planted. Cape provided initial stabilization then was crowded out by willows. Homeowners expectations were exceeded by the results of the planting which were preferable to rip-rap to the top of the bank.

5. Warm season grass cover for landfill reclamation at Roxbury and Williston VT, and Cortland, NY, using mixtures of 'Shelter' switchgrass, 'Niagara' big bluestem, 'Atlantic' coastal panicgrass, 'Bend' sand lovegrass, and 'Osage' or 'Rumsey' Indiangrass. These sites have soils with low percent of fines, droughty cap materials, especially in eastern NY and New England. The major obstacle to using warm season mix was the relatively slow establishment and the resulting possibility of erosion during the first summer. 'Atlantic' and 'Bend' provide improved establishment during this process, then they are dominated by the other species over time. Due to winter injury, 'Atlantic' is only reliable for the first 2 years in NY and northern New England. Other landfill sites such as Fresh Kills on Staten Island and Pelham Bay in the Bronx are now using this approach to provide long-term, low maintenance, high value wildlife cover.

6. Warm season grass seeding at the East Corinth landfill in eastern Vermont. The native grass seed was tracked in with a dozer. Seeding was a success, but engineers insisted that the site had to be mowed. The cover struggled under mowing but has become well established since mowing was abandoned as a maintenance strategy.

7. The Elizabeth copper mine tailings site in central Vermont. The site was bare and highly erosive for 40 years with no native plant establishment except for broadleaved cattail [*Typha latifolia* L.] in a wet spot. Plantings of warm season grass plots in 1988 demonstrated the ability of the major species to tolerate the heavy metal concentrations and low pH at the site. A light lime (1000 lbs ac^{-1}) and fertilizer application (40 lbs ac^{-1}) was made at planting and tracked in with the seed. No soil was applied to the site.

8. A titanium and iron mine in Tahawas, NY (eastern Adirondacks) Zone 4, 1500 ft elevation. Warm season grass mix, 1000 lbs. of lime and 80 lbs. of N-P-K were applied per acre, then tracked in with a dozer.

9. Sand bluestem is not native to the Northeast. Like sand lovegrass it is very useful in mixes destined for use on droughty, low-fines sites. 'Goldstrike' sand

bluestem from Nebraska is performing well after 10 years at the Swanton Airport in extreme northern Vermont, a few miles from Quebec Province (plant hardiness zone 3).

Southern New England/Mid-Atlantic

1. Watershed Protection Project in Berkshire Mountains, MA (elevation 1800') Indiangrass, big bluestem, and little bluestem were seeded in November 1997 along with cool season companion grasses, redtop and Canada wildrye. Light mulch was applied after seeding. The project site was fertilized in the early summer with a liquid fertilizer. By late summer 1998, seedlings of big and little bluestem were present on the site along with a good cover of redtop and scattered stands of Canada wildrye. After the second growing season (summer 1999), seedlings of all the native grasses seeded were evident throughout the project area with some individuals producing seedheads. Only very localized rill erosion had occurred during the native grass establishment period.

2. Hart-Miller Island, MD. This is a dredge containment facility for material dredged to keep the Baltimore Harbor shipping channel open. The containment dike is composed of unconsolidated coarse-textured sands and gravels. The dikes have a 1:1 slope (45 degree) slope which preludes the use of any seedbed preparation or seed drilling equipment on the slope. The grass mix composed of 'Atlantic' coastal panicgrass, 'Blackwell' switchgrass, weeping lovegrass, partridge pea, and 'Lathco' flat pea *[Lathyrus sylvestus* L.] was hydroseeded onto the slope. A chain was then dragged across the slope to improve seed to soil contact. Also, a liquid fertilizer was added to provide some nutrients to the sterile soil. A fully established stand was present after two growing seasons. Seven years after seeding the warm season grasses are persisting well.

3. Hopatcong Civic Center northern New Jersey. Warm season grasses were seeded on a barren, gravelly to cobbly outwash slope. Prior attempts to establish cool season grasses on the site were unsuccessful. The native seeds were broadcast and tracked in with a bulldozer. A full stand of native grasses developed within two growing seasons and is persisting five years after seeding.

4. Coastal strip (NJ, DE, MD). 'Atlantic' coastal panicgrass was successfully seeded in back dune areas between rows of beachgrass. Seeding has been done with a simple garden seeder (Planter Jr.) set at a 1 1/2"-2" depth. Seedlings emerging the first year generally ranged from 2"-8" in height. Within three growing seasons, the coastal panicgrass crowded out American beachgrass, a pioneer plant, and dominated the site with the long-term cover.

Summary

Warm season grasses have become an important tool for conservation plantings in the Northeast. The benefits which these grasses bring to the planting site include long life, compatibility with forbs, superior root production, soil improvement, and wildlife habitat. Natural resource agencies should be finding ways to incorporate the use of these grasses in their programs, but are cautioned to utilize effective site selection and planting procedure criteria.

References

Dickerson, J.A., B. Wark, D. Burgdorf, R. Maher, A. Bush, W. Poole, and C. Miller. 1997. Vegetating with Native Grasses in Eastern North America. USDA-Natural Resources Conservation Service and Ducks Unlimited Canada. 63p.

Gaffney, F.B. and J.A. Dickerson. 1987. Species Selection for Revegetating Sand and Gravel Mines in the Northeast. Journal of Soil and Water Conservation. 42:358-361.

Vickery, P.D. and P.W. Dunwiddie. 1997. Grasslands of Northeastern North America. Massachusetts Audubon Society, Lincoln, MA. 297p.

Weaver, J.E. 1968. Prairie Plants and Their Environment. University of Nebraska Press, Lincoln, NE. 276p.